

**SITE SPECIFIC PROJECT PLAN FOR:  
DEVELOPMENT OF THE PROVINCE LAKE WATERSHED PLAN: PHASE 1  
(NHDES Project # R-12-S-08)**

**Under the New Hampshire Section 319 Nonpoint Source Grant Program QAPP  
RFA# 08262  
October 17, 2008**

FINAL  
(4/11/2013)

Prepared by:  
FB Environmental Associates  
97A Exchange Street, Suite 305  
Portland, ME 04101

**For Review:**

Technical Project Manager:

\_\_\_\_\_  
Signature/Date  
Forrest Bell, FBE

Task Manager/QA Officer:

\_\_\_\_\_  
Signature/Date  
Jennifer Jespersen, FBE

Task Manager:

\_\_\_\_\_  
Signature/Date  
Cayce Dalton, FBE

NHDES Project Manager:

\_\_\_\_\_  
Signature/Date  
Sally Soule, NHDES

Program Quality Assurance Coordinator:

\_\_\_\_\_  
Signature/Date  
Jillian E. McCarthy, NHDES

NHDES Quality Assurance Manager:

---

Signature/Date  
Vincent Perelli, NHDES

**For Receipt:**

EPA Nonpoint Source Program Coordinator:

---

Signature/Date  
Erik Beck, EPA Region 1

**Table of Contents**

1- Distribution List .....4  
2- Project Organization .....4  
3- Site Information .....7  
4- Project Rationale .....7  
5- Project Approach/Study Design.....9  
A. Evaluate Water Quality Data .....9  
B. Assimilative Capacity & Water Quality Goal Setting .....10  
C. Identify Current and Future Pollutant Loading.....10  
D. Watershed and Septic Survey .....13  
6- Project Schedule.....13  
7- Documents and Records .....14  
8- Quality Control .....14  
9- Final Products and Reporting.....15  
10-References .....16  
Appendix A- Province Lake Watershed Map .....17

**Tables**

Table 1. SSPP Distribution List .....4  
Table 2. Personnel Responsibilities and Qualifications .....7

**Figures**

Figure 1. Project Organizational Chart .....6

## 1- Distribution List

Table 1 lists people who will receive copies of the approved Site Specific Project Plan (SSPP) under the *New Hampshire Section 319 Nonpoint Source Grant Program Quality Assurance Project Plan* dated October 17, 2008.

**Table 1. SSPP Distribution List**

SSPP Recipient Name	Project Role	Organization	Telephone number and e-mail address
Carl Davis	Project Manager	Province Lake Association	<a href="mailto:Davis4Q@metrocast.net">Davis4Q@metrocast.net</a>
Forrest Bell	Technical Project Manager	FB Environmental	<a href="mailto:info@fbenvironmental.com">info@fbenvironmental.com</a> 207-221-6699
Jennifer Jespersen	Task Manager	FB Environmental	<a href="mailto:jenj@fbenvironmental.com">jenj@fbenvironmental.com</a> 207-221-6699
Cayce Dalton	Technical Team- Pollutant Load Modeling	FB Environmental	<a href="mailto:cayced@fbenvironmental.com">cayced@fbenvironmental.com</a> 207-221-6699
Linda Schier	Technical Team – Watershed and Septic Surveys	Acton Wakefield Watersheds Alliance	<a href="mailto:info@AWwatersheds.org">info@AWwatersheds.org</a> 603-473-2500
Dustin Johnson	Technical Team – Watershed and Septic Surveys	Acton Wakefield Watersheds Alliance	<a href="mailto:djohnson@AWwatersheds.org">djohnson@AWwatersheds.org</a> 603-473-2500
Sally Soule	NHDES Project Manager	NHDES, Watershed Management Bureau	<a href="mailto:sally.soule@des.nh.gov">sally.soule@des.nh.gov</a> 603-559-0032
Jillian McCarthy	Program QA Coordinator	NHDES, Watershed Management Bureau	<a href="mailto:jillian.mccarthy@des.nh.gov">jillian.mccarthy@des.nh.gov</a> 603-271-8475
Vincent Perelli	NHDES QA Manager	NHDES, Planning, Prevention, & Assistance Unit	<a href="mailto:vincent.perelli@des.nh.gov">vincent.perelli@des.nh.gov</a> 603-271-8989
Erik Beck	USEPA Project Manager	USEPA New England	<a href="mailto:beck.erik@epa.gov">beck.erik@epa.gov</a> 617-918-1606

## 2- Project Organization

The Province Lake Association received funding under Section 319 of the Clean Water Act from the NH Department of Environmental Services (NHDES) in order to develop a Watershed Management Plan (WMP) for the Province Lake Watershed.

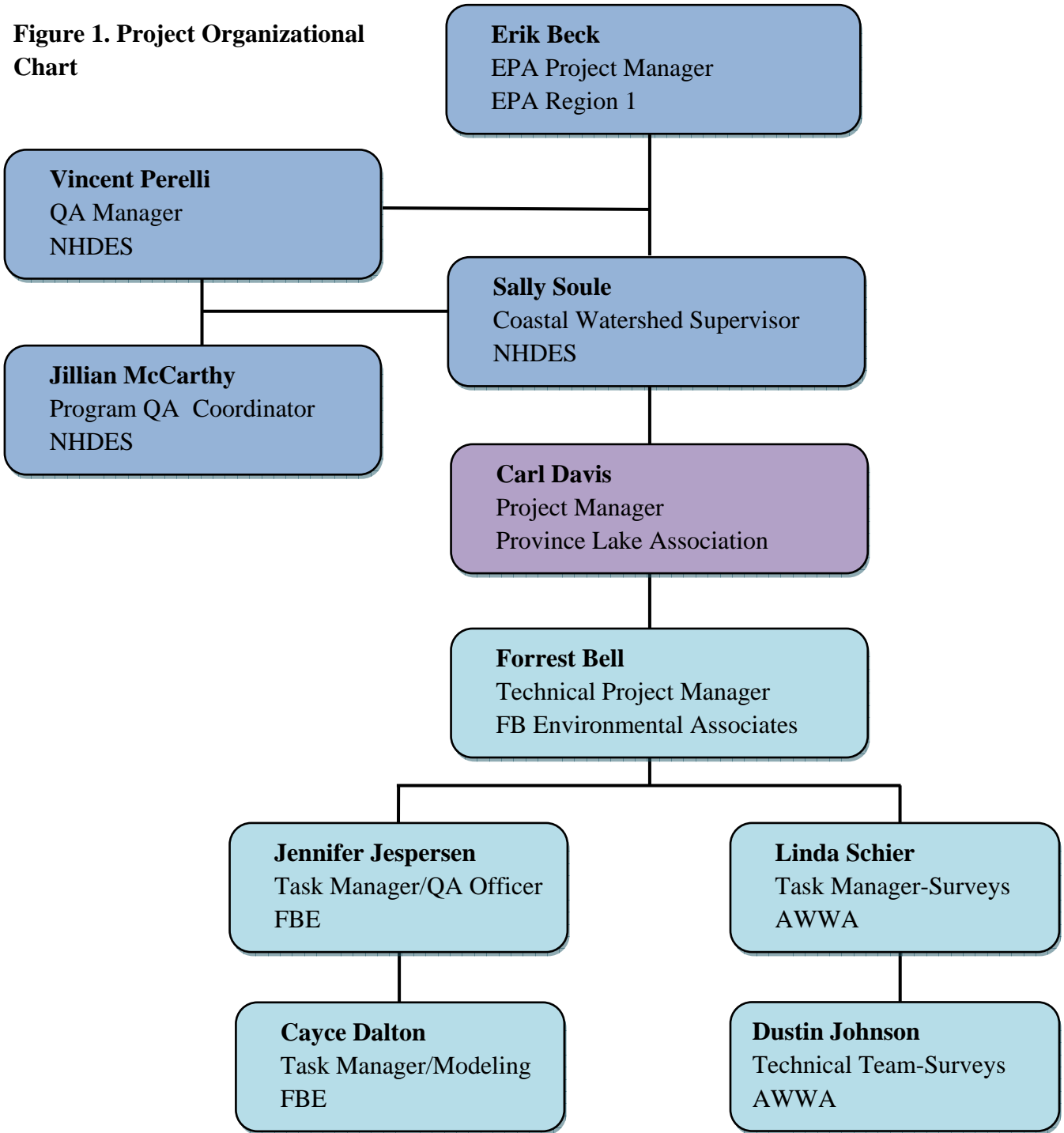
FB Environmental Associates (FBE) was selected as the technical consultant to help complete the scope of services for the Province Lake Association. FBE Technical Project Manager, Forrest Bell, will provide project oversight, technical expertise, and serve as the main point of contact for the Province Lake Watershed Plan Steering Committee.

Jennifer Jespersen will serve as Task Manager and QA Officer for the project. She will work closely with the Province Lake Association and Project Team to ensure that the project stays on time and within budget. Jennifer is in charge of managing key project personnel. Jennifer will provide technical expertise and oversight for key modeling tasks including the land use modeling, in-lake phosphorus and assimilative capacity analysis, buildout analysis, and pollutant load reduction estimates. Jennifer will also conduct the water quality analysis. Task Manager, Cayce Dalton, will conduct lake modeling tasks. Jennifer will conduct QA/QC for the BMP reduction calculations and the lake modeling. As the QA officer, Jennifer will ensure that survey results and modeling results have been reviewed and double-checked for potential inconsistencies.

The data generated by this project will be used by NHDES, the Province Lake Association, and their subcontractors to develop a watershed management plan for Province Lake.

Figure 1 outlines the organization structure of the project personnel.

**Figure 1. Project Organizational Chart**



**Table 2. Key Project Personnel Responsibilities and Qualifications**

<b>Name and Affiliation</b>	<b>Responsibilities</b>	<b>Qualifications</b>
Carl Davis Province Lake Association	Project Manager	On file at Province Lake Association
Forrest Bell FB Environmental	Senior Scientist; Project Manager	On file at FB Environmental
Jennifer Jespersen FB Environmental	Task Manager; Project QA/QC Officer	On file at FB Environmental
Cayce Dalton FB Environmental	Task Manager; Pollutant Load Modeling	On file at FB Environmental
Linda Schier AWWA	Task Manager, Watershed and Septic Surveys	On file at AWWA
Dustin Johnson AWWA	Technical Team, Watershed and Septic Surveys	On file at AWWA
Sally Soule, NHDES Watershed Management Bureau	Reviews and oversees development of the Province Lake Watershed Plan	On file at NHDES
Jillian McCarthy, NHDES Watershed Management Bureau	Reviews QAPP preparation and other QA/QC activities	On file at NHDES
Vince Perelli, NHDES Planning Prevention & Assistance Unit	Reviews and approves QAPPs	On file at NHDES
Erik Beck US EPA Region I	EPA Project Manager	On file at US EPA

### **3- Site Information**

The Province Lake watershed is 7.5 square miles in area, and the lake itself is approximately 1.5 square miles in area. The watershed is located primarily in Effingham and Wakefield, NH, and Parsonsfield, ME, with small additional portions in Ossipee, NH, and Newfield, ME. The primary tributaries to the lake are the South River and Hobbs Creek, plus additional unnamed tributaries. See Appendix A for the map.

### **4- Project Rationale**

Phosphorus is a limiting nutrient in freshwater ecosystems. Excess phosphorus in these systems can lead to nuisance algal blooms and low water clarity. High levels of phosphorus in freshwater lakes and streams are often associated with human activities resulting from stormwater runoff, excessive use of fertilizer, and poorly maintained/malfunctioning septic systems.

Province Lake is listed on New Hampshire's draft 2012 Section 303(d) Surface Water Quality List (NHDES 2012) of impaired waters by the New Hampshire Department of Environmental

Services (NHDES) as impaired for Aquatic Life Use due to chlorophyll-a and total phosphorus levels, and is listed for Primary Contact Recreation for cyanobacteria hepatotoxic microcystins. The lake was also listed on the 2012 303 (d) list as impaired for lake nutrients due to high levels of phosphorus and chlorophyll-a (Chl a).

The purpose of this project is to develop the Province Lake Watershed Plan to promote control of nonpoint source pollution from the watershed. This is expected to improve the trophic status of the lake, reversing the trend towards increasing productivity as evidenced by the current high concentrations of phosphorus and chlorophyll-a observed in the lake. The lake also experiences frequent cyanobacteria blooms. This project will evaluate existing water quality data, conduct watershed modeling, and gather watershed data through stormwater and septic surveys to support the development of a watershed-based management plan that will help maintain or improve the waters of the Province Lake watershed.

The project will identify and provide recommendations to address watershed-based land use activities that are likely causing nutrient enrichment of the lake. The plan will evaluate and recommend strategies for addressing impacts including: a) roadside runoff into the lake and its tributaries as well as runoff from Route 153; b) runoff from activities such as land clearing, construction, conversion of seasonal camps to year-round use, use of fertilizers, and recreational activities; c) erosion from poorly buffered shoreline properties and artificially created beaches; and d) runoff from parking lots adjacent to tributaries and lake shorelines.

Septic systems are a concern for Province Lake. Many cottages near the lakeshore are older and the status of many septic systems (age, type, location, pump out rate, etc.) is unknown. Province Lake is situated in a region with sandy soils with high hydraulic transmissivity, meaning that soils may not adequately filter phosphorus that is exported from septic systems. Therefore, the plan will include a component to evaluate the effect of septic systems on the lake. Information will be gathered and evaluated regarding the impact of septic systems within 250 feet of tributaries and lake shorelines. The survey will also cover the Towle Farm neighborhood, which is a densely settled, “back lot” developed area near the lake.

The watershed modeling for this project will estimate total phosphorus loading into the lake, assess loading from major tributaries, predict loading from future development, and help establish water quality goals.

Septic and stormwater field surveys will be conducted to collect baseline information about the state of the septic systems and stormwater runoff around the lakes. This information will be used to estimate phosphorus loading from the developed areas in the watershed and to provide



information to develop recommendations for Best Management Practices (BMPs) to reduce pollution. Results from the surveys will also be used to educate watershed citizens about nonpoint source pollution and how it affects lake water quality.

## **5- Project Approach/Study Design**

Several watershed survey techniques and watershed models will be used to complete the watershed management plan. On-the-ground stormwater and septic surveys, combined with in-depth water quality analysis and computer modeling, will be used to identify sources of pollution and to estimate pollutant load reductions needed to accommodate future watershed development. The survey forms are found in Appendices B and C.

This SSPP covers the water quality data evaluation, watershed modeling, and the septic and stormwater surveys.

### **A. Evaluate Water Quality Data**

Historical water quality monitoring data will be used for determining the median phosphorus values, the indirect phosphorus load to Province Lake, the internal load, the assimilative capacity, and for determining the water quality goal for each of the lakes. Data up to 10 years old will be considered. In cases where only data older than 10 years are available, in particular for evaluating nutrient attenuation rates within tributary basins within the Lake Loading Response Model (LLRM) model, those data may also be considered. Monitoring results will be collected and reviewed from in-lake sources and tributaries to calibrate modeling efforts. The New Hampshire Volunteer Lake Assessment Program (VLAP) is the primary group collecting water quality data on Province Lake. Historical data from NHDES lake trophic surveys will also be used. All data are expected to be accessible through the New Hampshire Department of Environmental Services Environmental Monitoring Database (EMD). Only data that is flagged as final in the EMD will be used, as those data are considered to have been accepted by an authoritative source (NHDES) utilizing its own QA/QC processes.

Previously collected water quality data for Province Lake will be used to assess pollutant levels in the lake and to help provide an estimate of inputs by subwatershed. Water quality data will be combined into a common spreadsheet for each waterbody, and then sorted by date and station for Quality Assurance/Quality Control (QA/QC) in order to avoid duplicating data sets. All duplicates will be removed. An initial analysis will be conducted to determine median Total Phosphorus (TP) based on all samples regardless of whether it was a grab or epilimnetic core (EC) sample. Minimum, maximum and median TP values will be determined for each station, sorted by epilimnion, metalimnion and hypolimnion. Data will be further refined using EC data only to calculate the median EC value (where more than one sample was collected on

the same day, a mean will be used for that day). In the event that EC data are limited, grab samples taken on the same day at multiple depths near the surface may be used in conjunction with the EC samples. Best professional judgment by FBE, with input from NHDES, will be used to determine which station is most representative of the whole lake, and factors such as location, depth, and temporal pattern and extent of data will be considered. In general, stations which are closer to the deep hole, more centrally located, and with a long history of data spanning all seasons and weather conditions are preferred. If needed and if adequate data exist, statistical analysis (*e.g.*, paired t-test) may be used to determine whether significant differences exist between stations on the same lake. Similar methodology will be used to calculate average Chl *a* and Secchi disk transparency (SDT).

## **B. Water Quality Goal Setting**

Province Lake is classified by the New Hampshire Department of Environmental Services (NHDES) as impaired for aquatic life due to Chl *a* and total phosphorus levels, and is impaired for primary contact recreation for cyanobacteria hepatotoxic microcystins on the draft 2012 Section 303(d) Surface Water Quality List (NHDES 2012). A goal of the project is to determine the pollutant load reductions needed to meet water quality standards. As such, the water quality goals for Province Lake will focus on phosphorus and Chl *a*. The process of establishing water quality goals will be guided by data analyses conducted by FB Environmental (FBE).

Once the median water quality has been determined for the lake, an assimilative capacity analysis will be conducted for the lake to verify the lake's impaired classification. Impaired waters have a negative assimilative capacity and require reductions in pollutant loading in order to restore the waterbody. The assimilative capacity analysis will be conducted using procedures described in the Assimilative Capacity Analysis for New Hampshire Waters (NHDES, 2008). The NH 2012 Consolidated Assessment Listing Methodology will then be used to recommend appropriate water quality goals to achieve restoration.

Once the initial calculations are completed and appropriate guidance materials have been reviewed, a subcommittee consisting of representatives of the Province Lake Association, NHDES staff, and other stakeholders will finalize the water quality goals.

## **C. Identify Current and Future Pollutant Loading**

### Watershed Loading Model

Geographical Information Systems (GIS) data will be obtained by FB Environmental to assist with the land use assessment and specifically for determining the total land use area by land use type (in acres) for input into the watershed loading model (see below for model selection

criteria). GIS land use data are available from the State of New Hampshire GIS website (GRANIT). The NH Land Cover Assessment 2001 or NHLCO1, consists of the most recent and detailed classification of land cover in New Hampshire based on satellite images acquired between 1990 and 1999, with further revisions in 2001 (GRANIT). For the portions of the watershed in Maine, data will be obtained through the Maine Office of GIS, and will include the *Landcover - MELCD 2004* layer. This data will be used for the land use loading analysis as described below in the section titled, *Future Loading Model/Build-Out Analysis*. GIS land use coverages will be ground-truthed by FB Environmental based on field observations and using publicly available recent aerial photography to ensure the best coverages for input into the model.

The Lake Loading Response Model (LLRM) (also called SHEDMOD or ENSR-LRM) will be used to assess current nutrient loads from the watershed, and the load reductions that would result from the implementation of different best management practices (BMPs). The model was developed by AECOM for use in New England and modified for New Hampshire lakes by incorporating New Hampshire land use total phosphorus TP export coefficients and adding septic system loading into the model (AECOM, 2009). This model provides the best fit for the watershed and has been used extensively for more than 30 recent Lake TMDLs in New Hampshire. A recently completed and NHDES-approved LLRM model version, such as the one used in Lake Wentworth in 2012, will be used as the starting point. The LLRM User Guide contained in the *Total Maximum Daily Load for Robinson Pond, Hudson, NH* (AECOM and NHDES, 2011) will serve as the primary documentation on the model.

Data needed for input into the LLRM include: water quality monitoring data (TP, Chl *a*, and Secchi) for both lakes; physical characteristics such as lake surface area, volume and flushing rate; tributary monitoring data including discharge; corrected GIS land use data; subwatershed land area; precipitation data; septic system data (typically available from the US Census Bureau). Cayce Dalton of FBE will be running the model. Cayce is proficient in the use of watershed loading models, having direct experience with AVGWLF, PREDICT, and the USEPA Region 5 Model. FBE Senior Project Manager Jennifer Jespersen will provide technical oversight and confirm that the information used for the model is correct. NHDES will provide technical assistance and review of modeling methods and results. Cayce will make edits to the model based on feedback from Jennifer Jespersen, NHDES, and the Steering Committee.

The LLRM model estimates total phosphorus loading from the watershed, and predicts in-lake concentrations of TP, Chl *a*, SDT and algal bloom probability based on land use export coefficients for water and total phosphorus. Attenuation factors such as porous soils, wetlands,

ponds along tributaries, or existing BMPs that would decrease loading will be accounted for in order to reach a close agreement between predicted in-lake TP and observed median TP. The estimated watershed load (runoff and base flow) will be combined with direct loads (atmospheric, internal load and septic systems) to calculate total phosphorus loading and will be compared to observed in-lake concentrations.

#### *In-Lake Total Phosphorus Concentrations*

Results of the total phosphorus modeling will be input into a series of empirical models that provide predictions of in-lake TP concentrations, Chl *a* concentrations, algal bloom frequency and water clarity. Also referred to as total phosphorus retention modeling, the model estimates in-lake phosphorus concentrations based on physical and chemical lake characteristics including lake volume, mean depth, watershed area, flushing rate, and estimated watershed phosphorus loading. Because of the imperfect nature of any model to predict processes within natural systems, the model will compare six different in-lake phosphorus models including: Kirchner-Dillon (1975), Vollenweider (1975), Larsen-Mercier (1976), Jones-Bachman (1976), Reckhow General (1977), and Nürnberg (1998). The average of the six empirical models will be used as the predicted TP value for each of the lakes with some exceptions (it may be determined that one of the models is most representative, or a model could be eliminated as inapplicable, which will be documented both in the model spreadsheet and in all applicable reports). The predicted in-lake TP concentration will be compared to actual in-lake water quality data analysis (see 5A, above). Additional predictions (Chl *a*, water clarity and bloom probability) will be determined based on the average in-lake TP concentration.

#### *Future Loading Model/Build-Out Analysis*

FB Environmental will conduct a buildout analysis for analyzing the effects of new development on Province Lake. The buildout analysis utilizes GIS zoning data and CommunityViz software to estimate future development within the watershed. The analysis will combine projected population estimates, current zoning restrictions, and a host of additional development constraints (conservation lands, steep slopes, wetlands, existing buildings, soils with development suitability, unbuildable parcels) in order to determine the extent of buildable area in the watershed. Future phosphorus loading will be estimated under full or partial buildout (depending on the timeline of full buildout) and an assessment of the potential effects of future development as it relates to water quality goals. The buildout analysis will be conducted by Tricia Rouleau. Tricia is proficient in the use of CommunityViz, having used it for several similar watershed-based planning projects in both Maine and New Hampshire. Task manager Jennifer Jespersen will provide QA/QC of the buildout data inputs and results of the analysis. This model has been used on previous Watershed Restoration Grant

planning projects including Lake Wentworth and the Salmon Falls Headwaters Lakes Watershed Management Plan.

#### **D. Stormwater and Septic Survey**

FB Environmental (FBE) in collaboration with Acton Wakefield Watersheds Alliance (AWWA) will work with local volunteers to conduct a door-to-door canvass of watershed properties to determine residential septic system and stormwater impacts.

An estimated 600-700 properties will be divided into sectors and each property will be visited twice - once for the stormwater survey in May and the second time for septic survey in August - by a team consisting of at least one technical leader. Technical leaders will be drawn from staff of FBE, NH DES, and AWWA cited in Table 1. Field sheets (see Appendix B and C) will be completed for each property (by address, name and tax map#/lot#), and informational brochures on stormwater and septic systems will be distributed to landowners. Information on current stormwater management/septic practices will be gathered by observation and by asking a brief set of questions to each landowner. It is assumed that some landowners will not be available on the dates of the surveys. If the landowner is not home during the septic survey, technical staff will leave a survey asking the landowner to send the information in by mail. Field sheets to track the number of volunteer hours and any mileage incurred by volunteers to conduct the surveys will be created for match tracking purposes.

The stormwater survey will be conducted in May to document sources of pollution on residential sites within the watershed. The survey will include a checklist documenting sources of pollution including, but not limited to: roadside runoff into tributaries, direct runoff to lakes, runoff from development, conversion of seasonal to year-round residences, use of fertilizers, gravel excavation, erosion from poorly buffered properties and artificially created beaches, and runoff from parking lots adjacent to tributaries and shorelines. A survey sheet will be filled out for each residential site as well as for other sites throughout the watershed (Appendix C).

The septic survey will be conducted in August and will consist of a one-page survey of questions including: type of system, age of system, use (year-round or seasonal), occupancy, distance to waterbody, pumping frequency, and types of water-using machines. In addition, several questions are designed to learn more about the landowner's perceptions of water quality (Appendix B). Sector maps will be designed in GIS to track sites within designated "shores" throughout the watershed.

## **6- Project Schedule**

Project components are scheduled to be completed at different stages throughout the planning process. Below is a list of targets for completion of individual tasks.

Task 1: Final Site Specific Project Plan – May 1, 2013

Task 2: Evaluate Water Quality Data – June 1, 2013

Task 3A: Conduct Watershed Survey – Conducted by May 18 and completed June 30, 2013.

Task 3B: Conduct Septic Survey – September 15, 2013

Task 4: Establish and Approve Water Quality Goal – October 1, 2013

Task 5: Identify Current and Future Pollutant Sources Including Conducting a Buildout Analysis, including Lake Loading Response Model – January 1, 2014

Task 6: Estimate Pollutant Load Reductions to Meet Water Quality Goal – January 15, 2014

Task 7: Develop First Draft of the Watershed Management Plan – April 1, 2014

Task 8: Develop Second and Final Draft of the Watershed Management Plan – October 1, 2014

## **7- Documents and Records**

The FBE Technical Project Manager will ensure that project personnel have the most current version of the SSPP, including applicable model documentation and field data forms. Information gathered from the surveys will be entered into Excel spreadsheets by FBE and AWWA Task Managers and used to develop a survey report, estimate phosphorus loading from septic systems in the watershed during watershed modeling, develop a matrix of prioritized stormwater sites, and will be incorporated into the total phosphorus loading model in the watershed management plan. Field forms will be kept on file at the FBE office for a minimum of 3 years following completion of the project.

## **8- Quality Control**

Quality control checks will be performed by the FBE Task Manager to ensure that information collected during the survey is accurately entered into the spreadsheets. QA/QC checks will be conducted on a series of random field survey forms, and the spreadsheets will be reviewed for inconsistencies. If errors are identified, the associated FBE or AWWA Task Manager will review the input values, and identify and correct the error to ensure the correct information is entered into the spreadsheets. In addition, the FBE Task Manager Jen Jespersen will review all modeling inputs, calculations, and outputs for the purpose of QA/QC. All QA/QC issues identified will be properly documented, along with the appropriate steps taken to resolve the issues.

## **9- Final Products and Reporting**

Final products for this project will all be submitted by FB Environmental, and include the following:

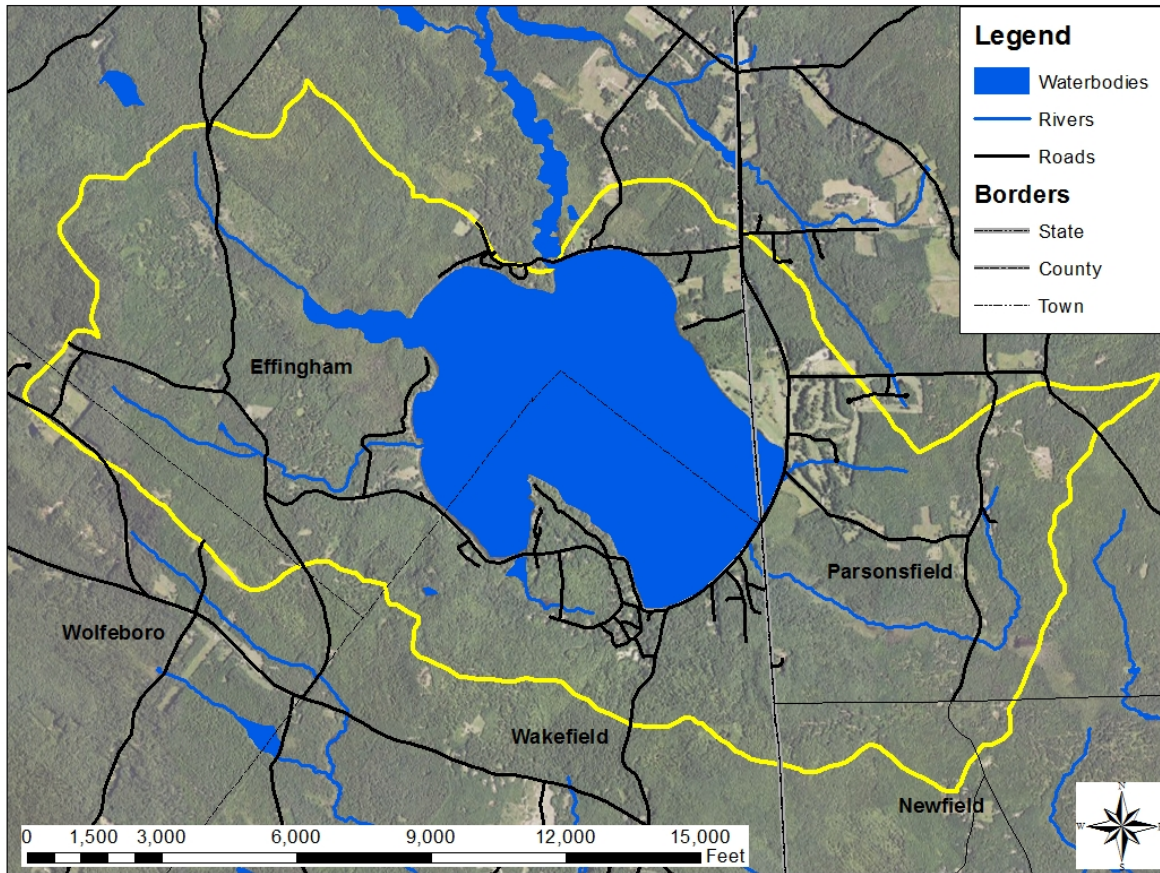
- Approved Site Specific Project Plan under the New Hampshire Section 319 Nonpoint Source Grant Program QAPP for the Septic and Stormwater Survey (RFA# 08262, 10/17/08).
- Summary of methods and calculations to determine Assimilative Capacity.
- Documentation of water quality goal and methods.
- Buildout summary report and data; estimation of background levels of phosphorus.
- Final modeling report, including final in-lake response calculations.
- Watershed and septic survey results, with report.
- Final pollutant load reduction estimates.
- GIS maps associated with land use coverage and in-lake response model results.
- Draft and final watershed plans.

## 10-References

- AECOM and NHDES, 2011. Total Maximum Daily Load for Robinson Pond, Hudson, NH. Original AECOM Document Number: 09090-107-13, July 2009. Final revisions by NHDES in January 2011. Prepared for US EPA Region 1.
- AECOM, 2009. Draft Total Maximum Daily Load for Webster Lake, Franklin, NH. Document Number: 09090-107-28. July 2009. Prepared for US EPA Region 1, Project: EPA-SMP-07-002 by AECOM Environment, Belmont, NH.  
<http://des.nh.gov/organization/divisions/water/wmb/tmdl/documents/robinson-pond.pdf>
- EMD. New Hampshire Environmental Monitoring Database. New Hampshire Department of Environmental Services.  
[www2.des.state.nh.us/OneStop/Environmental\\_Monitoring\\_Menu.aspx](http://www2.des.state.nh.us/OneStop/Environmental_Monitoring_Menu.aspx).
- Kirchner, W. and P. Dillon. 1975. An Empirical Method of Estimating the Retention of Phosphorus in Lakes. *Water Resources Res.* 11:182-183.
- Larsen, D. and H. Mercier. 1976. Phosphorus Retention Capacity of Lakes. *J. Fish. Res. Bd. Can.* 33:1742-1750.
- Jones, J. and R. Bachmann. 1976. Prediction of Phosphorus and Chlorophyll Levels in Lakes. *JWPCF* 48:2176-2184.
- NHDES. 2012. Section 303(d) Surface Water Quality List (Draft). New Hampshire Department of Environmental Services. April 20, 2012. NHDES-R-WD-12-1
- NHDES. 2008. Standard Operating Procedures for Assimilative Capacity Analysis for New Hampshire Waters. April 15, 2008 (Draft). In: *Guidance for Developing Watershed Management Plans in New Hampshire*. New Hampshire Department of Environmental Services. May 22, 2008 (Second Draft).
- Nürnberg, G.K. 1998. Prediction of annual and seasonal phosphorus concentrations in stratified and polymictic lakes. *Limnology and Oceanography*. 43(7): 1544-1552.
- NH GRANIT. [www.granit.unh.edu](http://www.granit.unh.edu).
- Reckhow, K. 1977. Phosphorus Models for Lake Management. Ph.D. Dissertation, Harvard University, Cambridge, MA.
- Vollenweider, R.A. 1975. Input-output models with special references to the phosphorus loading concept in limnology. *Schweiz. Z. Hydrol.* 37:53-62.



## Appendix A- Province Lake Watershed Map



# Appendix B- Province Lake Septic Survey Questionnaire

Sector-Site \_\_\_\_\_

Surveyors \_\_\_\_\_

## 2013 PROVINCE LAKE SEPTIC SURVEY

Thank you for participating in the Province Lake Septic Survey! If you are receiving this questionnaire that means you missed our visit. **Please help us complete this survey by filling out the questionnaire by mail, or online at [www.fbenvironmental.com/province.html](http://www.fbenvironmental.com/province.html).**

The Province Lake Septic Survey is a part of the Province Lake Watershed Plan currently being developed by the Province Lake Association. In order to develop an accurate lake response model and to evaluate the potential cumulative impacts that septic systems around the lake may have on lake water quality, we are visiting properties within 250 feet of the lake and its tributaries. The information will provide a better understanding not only of the state of the septic systems in the area, but will also help us to identify opportunities for future outreach activities and where resources may be needed.

1. **On a scale of 1 to 10, where ten is the best, what is your perception of the water quality in Lake Wentworth and Crescent Lake?** (circle one) 1 2 3 4 5 6 7 8 9 10

2. **Do you have a septic system, or other wastewater system?** (circle one)

Septic      Overboard Discharge      Holding Tank      Cesspool/Outhouse  
Town/Other \_\_\_\_\_

3. **Do you know where your septic tank and leach field are located?** (circle one)

Yes                  No                  Not Sure

4. **How old is the septic system?** (circle one)

1-10 years    10-15 years    15-20 years    20-25 years    I don't know

5. **How old is the house?** (circle one)

1-10 years    10-15 years    15-20 years    20-25 years    I don't know

6. **Is this home used year-round or seasonally?** (circle one)

Year Round                  More than one season (50-150 days/year)                  Seasonal (less than 50 days/year)

7. **What's the average occupancy?** (circle one)

1-2 people                  2-4 people                  4-6 people                  More than 6 people

8. **What is the approximate distance of your septic system from the lake or stream?** (circle one) Lake or Stream?

0-10 feet    10-20 feet    20-50 feet    50-75 feet    Greater than 75 feet    I don't know

9. **How often do you have your septic tank pumped?** (circle one)

Every 1-2 years    Every 3-5 years    Every 6-10 years    More than 10 years    I don't know

10. **When was the last time it was pumped?** \_\_\_\_\_

11. **Which of the following water-using machines do you have in your house/camp?** (circle all that apply)

Washing Machine    Garbage Disposal    Dishwasher    Water Softener    Other \_\_\_\_\_

**IMPORTANT: PLEASE FILL OUT THE BACK OF THIS SURVEY!**

Date \_\_\_\_\_

Time \_\_\_\_\_

Visit # \_\_\_\_\_

# Appendix C- Province Lake Stormwater Survey Questionnaire

Sector-Site \_\_\_\_\_

Surveyors \_\_\_\_\_

12. When buying laundry detergents or dish detergents, do you check the labels to buy no-phosphate or low phosphate products? (circle one)

No, not really                      Sometimes                      Always, most of the time

13. If you have a garbage disposal, how often do you use it when you are at the house? (circle one)

Always                      Frequently                      Seldom                      Never

14. Do you have a grassed lawn area within 100 feet of the water? (circle one)

Yes                      No

14A. If Yes, do you use: (circle one)

No Fertilizer                      No-Phosphate Fertilizer                      Low Phosphate Fertilizer                      I don't know

15. How willing (where 10 is most willing) would you be to make improvements to your property to help protect the lake's water quality if technical assistance were provided? (circle one)    1   2   3   4   5   6   7   8  
9   10

16. Would you be willing to allow members of the project team to return to your property later this season to collect a soil sample (with a shovel) in order to characterize the soils around the lake?    Yes                      No

Last Name: \_\_\_\_\_ Property Address: \_\_\_\_\_

Map/Lot # (if known): \_\_\_\_\_

This site is a good candidate for an AWWA / Youth Conservation Corps restoration project.

Yes, please send me results of this survey, and enter me in the raffle for the \$50 gift certificate to a local Wolfeboro restaurant.

My email address is: \_\_\_\_\_

**THANK YOU!**

**Please Send Completed Questionnaire by September 1, 2013 to:**

Province Lake Septic Survey  
c/o FB Environmental Associates  
420 Court Street  
Portsmouth, NH 03801

**Or**

**Fill Out the Questionnaire Online at:**  
**[www.fbenvironmental.com/province.html](http://www.fbenvironmental.com/province.html)**

Date \_\_\_\_\_

Time \_\_\_\_\_

Visit # \_\_\_\_\_